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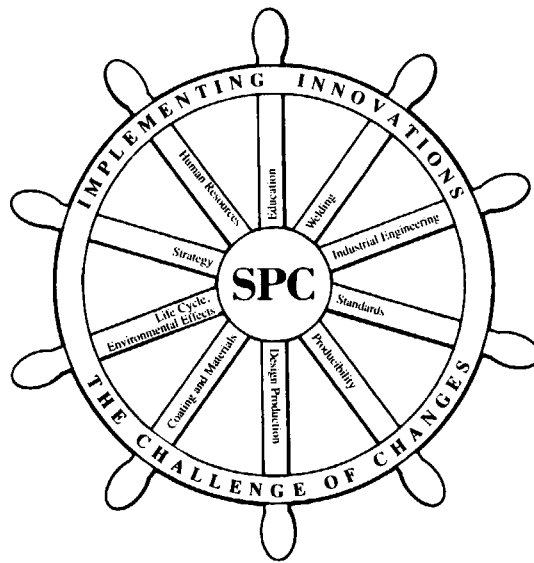
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Environmental Pollution Control: Regulatory Considerations and a Case in Point

No. 2A-1

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ABSTRACT

During recent years, the United States has paid increasing attention to controlling and minimizing environmental pollution. One result of this attention is the development of new laws and regulations, enforced by the Environmental Protection Agency (EPA) and by state and local agencies. These new environmental laws and regulations are considerably more stringent than those of past years and they directly impact how shipyards must conduct their operations. This paper discusses these laws and regulations at the national, state (including California, Virginia and Connecticut), and local levels.

With the environmental regulatory background in focus, the paper proceeds to explore the effects of the regulatory trend on one particular segment of the shipbuilding and ship repair industry: floating drydocks. Floating drydocks provide an illuminating example, because of the environmentally sensitive industrial activities carried out on board, such as grit blasting and painting with antifouling paints. The operational norms of floating drydock pollution control are discussed, starting with present day commercial and Navy facilities, and culminating with the Navy's newest floating drydock design, the AFDB 10.

NOMENCLATURE

BMPs -	Best Management Practices, which are plans to minimize pollution by industrial facilities such as drydocks
CHT -	Collection, Holding and Transfer system for shipboard sewage
EPA -	The United States Environmental Protection Agency
NPDES -	National Pollution Discharge Elimination System
VPDES -	Virginia Pollution Discharge Elimination System

WQS - Water Quality Standards

INTRODUCTION

The United States is paying increasing attention to pollution control. One result of this attention is the development of new environmental requirements, enforced by the EPA and by state and local agencies (in the context of this report, "requirements" include laws, guidelines, standards, regulations and other legal limitations). These new requirements are considerably more stringent than those of past years and they directly impact how drydocks must conduct their operations.

The following presentation addresses the subject of pollution control by providing an overview of applicable regulatory requirements: examining selected approaches to successfully complying with those requirements; and presenting a recent design which is responsive to the requirements and builds upon past lessons learned.

In order to provide focus in what is a complex subject, the presentation explores the effects of the regulatory trend on one particular segment of the shipbuilding and ship repair industry: floating drydocks. Floating drydocks provide an illuminating example because of the environmentally sensitive industrial activities carried out on board, such as grit blasting and painting with antifouling paints. Other types of ships and marine structures will have their own particular requirements, but will also share many elements in common with floating drydocks.

TYPES OF POLLUTANTS AND APPROACHES TO THEIR CONTROL

Following is a description of the types of pollutants generally found on floating drydocks and approaches to their control (1,2,3).

Spent Abrasive

The most significant pollutants from

boards develop regulations and the administrative structure of a state water and air quality control program. When such a program is in place and accepted by the EPA, the EPA delegates its water and air quality control enforcement functions to the state, and the state board implements the functions through state and regional departments. Figure 1 illustrates a typical structure of the laws and regulations, and Figure 2 presents typical administrative structure for this approach.

Clean Water Act Clean Air Act

Water Pollution Control Law Air Pollution Control Law

Regulations for the Control and Abatement of Water Pollution	Regulations for the Control and Abatement of Air Pollution
1	

National Pollution Discharge Elimination System (NPDES) Permit	Memorandum of Understanding
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Best Management Practices Shipyard Procedures

The objective in controlling this pollutant is to prevent the discharge of spent abrasive overboard or the leaching of the heavy metals out of the spent abrasives as they lay on the deck (leaching agents include rain water and liquids that leak from sanitary waste lines, cooling water lines and air scrubber systems).

Shipboard sanitary waste includes "black" and "gray" water. Two alternatives exist for the proper handling of sanitary waste: (1) it may be discharged directly to a shipyard sewer system; or (2) it may be placed into a holding tank for subsequent removal from the drydock and drainage to a sewer system.

Miscellaneous trash and sediment accumulate on the floor of drydocks during shipbuilding and ship repair operations.- If not removed -prior to undocking, this material is discharged during ballasting. The discharge of trash and sediment may be minimized through the diligent use of waste receptacles or a thorough cleanup of prior to flooding.

An estimated 5 percent of the total paint to be applied to the hull is lost to the drydock and can be discharged to the receiving water. These losses include: paint spilled within the drydock; excess applied paint which drips to the floor of the dock; overspray due to improper use of; and wind carried paint which lands in the dock.

Generally speaking, state water and air quality control regulatory requirements derive from Federal laws, administered by the EPA. Each state builds upon the Federal laws, adds its own needs and concerns, and passes its own water and air quality control laws. These form the basis from which state

Federal Requirements

The Federal requirements consist of two laws, the Water Quality Act and the Clean Air Act (4, 5, 6). Each of these laws is discussed below.

Water Quality Control. Almost all of the EPA requirements that affect drydocks fall within the water quality control category, that is, within the Water Quality Act. Within the framework of this Act, the EPA requires that industrial direct dischargers of pollutants, such as floating drydocks, obtain and comply with a National Pollution Discharge Elimination System

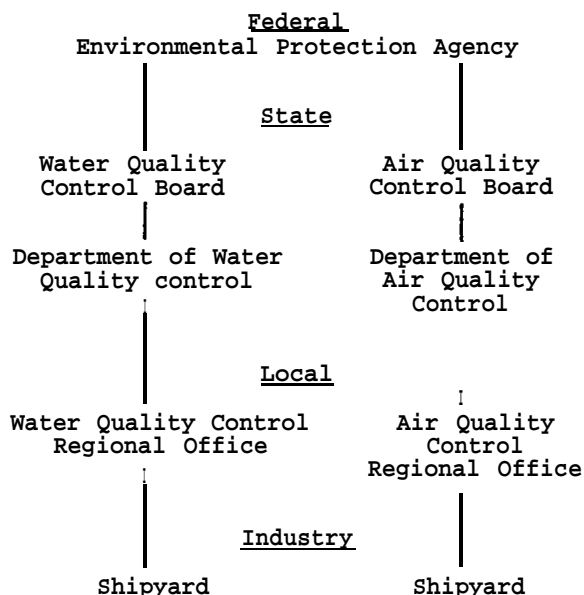


FIGURE 2
WATER AND AIR QUALITY CONTROL
TYPICAL ADMINISTRATION STRUCTURE

(NPDES) permit (7). This permit is tailored to each industrial facility and its aim, as its name implies, minimize pollution discharge. It does this by either stipulating discharge limitations and monitoring requirements, or stipulating Best Management Practices (BWPS).

The discharge limitations comprise numerical maximum amounts of named pollutants that the industrial facility may discharge during specific periods of time (e.g., weekly) into named waters (e.g., a bay or river). The monitoring requirements call for the industrial facility to monitor discharges for pollutants at specific intervals of time and to report the findings to the agency that issued the NPDES permit.

BWPs are designed to help minimize pollution discharges in those cases for which numerical discharge limitations are not practical. The BWPs are guidelines that are to be followed by the industrial facility in the conduct of its day-to-day operations. An example set of BWPs for drydocks is presented below.

BMP 1. control of Large Solid Materials. Scrap metal, wood and plastic, -miscellaneous trash such as paper and glass, industrial scrap and waste such as insulation, welding rods, packaging, etc., shall be removed from the drydock floor prior to flooding or sinking.

BMP 2. Control of Blasting Debris. Cleanup of spent paint and abrasive shall be undertaken as

part production activities the degree technically feasible to prevent its entry-into drainage systems. Mechanical cleanup may be accomplished by mechanical sweepers, front loaders, or innovative equipment. Manual methods include the use of shovels and brooms. Innovations and procedures which improve the effectiveness of cleanup operations shall be adapted, where they can be demonstrated as preventing the discharge of solids. Those portions of the drydock floor which are reasonably accessible shall be "scraped or broom clean" of spent abrasive prior to flooding.

After a vessel has been removed from the drydock and the dock has been deflooded for repositioning of the keel and bilge blocks, the remaining areas of the floor which were previously inaccessible shall be cleaned by scraping or broom cleaning prior to the introduction of another vessel into the drydock.

BWP 3. Oil, Grease, and Fuel Spills. During the drydocked period oil, grease, or fuel spills shall be prevented from reaching drainage systems and from discharging with drainage water. Cleanup shall be carried out promptly after an oil grease spill is detected.

BWP 4. Paint and Solvent spills Paint and solvent spills shall be treated as oil-spills and segregated from discharge water. Spills shall be contained until cleanup is complete. Mixing of paint shall be carried out in locations and under conditions such that spills shall be prevented from entering drainage systems and discharging with the drainage water.

BMP 5. Abrasive Blasting (Graving Docks) Abrasive blasting debris' in graving docks shall be prevented from being discharged with drainage water. Such blasting debris as deposits in drainage channels shall be removed promptly and as completely as is feasible.

BMP 6. Segregation of Waste Water Flows in Drydocks The various process wastewater streams

shall be segregated from sanitary wastes. Gate and hydrostatic leakage may also require segregation.

BMP 7. Contact Between Water and Debris. Shipboard cooling and process water shall be directed so as to minimize contact with spent abrasive and paint and other debris. Contact of spent abrasive and paint by water can be reduced by proper segregation and control of wastewater streams. When debris is present, hosing of the dock should be minimized. When hosing is used as a removal method, appropriate methods should be incorporated to prevent accumulation of debris in drainage systems and to promptly remove it from such systems to prevent its discharge with wastewater.

BMP 8. Maintenance of Gate Seals and Closure. Leakage through the gate shall be minimized by repair and maintenance of the sealing surfaces and proper seating of the gate. Appropriate channelling of leakage water to the drainage system should be accomplished in a manner that reduces contact with debris.

BWP 9. Maintenance of Hoses. Soil connections, valves, pipes, hoses, and soil chutes carrying either water or wastewater shall be replaced or repaired immediately. Soil chute and hose connections to the vessel and to receiving lines or containers shall be positive and leak free as practicable

BWP 10. Water Blasting, hydroblasting and Water Cone Abrasive Blasting (Graving Docks). When water blasting, hydroblasting, or water-cone blasting is used in graving docks to remove paint from surfaces, the resulting water and debris shall be collected in a sump or other suitable device. This mixture then will be either delivered to appropriate containers for removal and disposal subjected to treatment or: concentrate the solids for disposal and prepare the water for reuse or discharge.

Note that, while these BMPs address a variety of pollutants, the EPA's major concern with respect to potential water

pollution is with spent paint and abrasive blasting material. This concern is addressed by BWPs 2, 5, 7 and 10.

Air Quality Control Federal air quality requirements are presented in the Clean Air Act of 1990 (6). Note that certain drydock-related requirements are still in the developmental stage by EPA, examples of which follow (8).

Spray Painting - a control technique guideline is being written. It will be given to the states to assist them in writing their regulations and will be within the area of "marine vessel coating."

Sandblasting - No Federal regulatory initiatives are presently under way.

Diesel Engine Emissions - there will be additional NO_x requirements in the coming years. They will apply throughout the north-eastern U.S., mainly for major emitters, i.e., stationary internal combustion engines. For small engines, such as those typically found on floating drydocks for cranes or diesel-generators, these future EPA regulations would not apply (9).

Connecticut State and Local Requirements

As is the case with the Federal requirements, the state water and air quality control requirements are divided into the categories of water quality control and air quality control. A discussion of these requirements follows.

Water Quality Control Connecticut's water quality control program is based upon its "Water Quality Standards" (WQS)(10). These Standards set the overall policy for management of water quality in accordance with the directive of Section 22a-426 of the General Statutes of Connecticut. The WQS consists of three elements:

Standards for water quality, including classification of different water resources according to the desirable use, degradation, allowable types of discharges and fundamental principles of waste assimilation.

2. Criteria, consisting of descriptive and numerical standards, that describe the allowable parameters and goals for the various water quality classifications.

3. Maps, which show the classification assigned to each surface and groundwater resource throughout the state.

The presentation in the WQS is not to the level of detail of industrial activities, such as shipyards or ship repair facilities.

Air Quality control connection's air quality program is described in the "Regulations of Connecticut State Agencies, Abatement of Air Pollution" (11). The regulations are based on Section 22a-174 of the General Statutes of Connecticut. Included are sections that deal with registration and other instructions: regulations; and civil penalties. As with the water quality regulations, the treatment is not to the level of detail specific to certain industries, much less to drydocks.

Virginia State and Local Requirements

Following is a summary of Virginia's water and air quality control requirements.

Water Quality Control Virginia's water quality control requirements are set forth in the State Water Control Law, which is implemented by the Virginia Water Control Board, within the guidelines of the "Commonwealth of Virginia State Water Control Board Statutes" (12). As with other states, the Virginia Water Control Board is authorized by the EPA to administer the National Pollution Discharge Elimination System (NPDES) permitting program (13). Toward this end, Virginia issues Virginia Pollutant Discharge Elimination System (VPDES) permits, which tailor the NPDES regulations to the needs and conditions of Virginia. For example, shipyards are required to acquire VPDES permits for saecific effluent. and must provide BMPs control the pollutant loadings that are stated in those permits (14).

Virginia has focused particular attention on shipyards, and has developed a document entitled "Best Management Practices Manual for the Shipbuilding and Repair Industry (Draft)" (2) - This document provides 24 BMPs, of which the following directly impact the operation (and often the design) of floating drydocks:

- Sanitary Waste Disposal
- Gray Water Disposal
- Bilge and contaminated Ballast Water Disposal
- Leaking Pipe, Hose and Valve Connections
- Floating Drydock Cleanup
- Sally port Screening and Filtering
- Shrouding
- Water Cleaning
- Water Blasting, Hydroblasting, Water-Cone Blasting and Slurry Blasting.

Virginia's main area of concern regarding water pollution by drydocks is rain water runoff, which may contain entrained paint pollutants in blast grit as well as oil and grease (12).

An example of where the VPDES requirements are being used is the VPDES permit for the U.S. Navy's Sewells Point Naval Complex, Norfolk, Virginia. This VPDES permit is presently in the draft form and specifically addresses the BMP areas described above. Following are examples of practices stipulated in this permit (15).

Acceptable methods of control shall be utilized during abrasive blasting and spray painting, with the intent of preventing blast dust and overspray from falling into the receiving water. These include the following: downspraying of blast materials and paint: barriers or shrouds beneath the hull: barriers or shrouds between the hull and the wing walls of the drydock: and barriers or shrouds hung from the flying bridge to the drydock, from the bow or stern of the vessel, or from temporary structures erected for that purpose.

When water blasting. hydroblasting, or water-cone blasting is used to remove paint from surfaces, the resulting water and debris shall be collected in a sump or other suitable device. This mixture then will b e either delivered to appropriate containers for removal and disposal subjected to treatment to concentrate the solids for proper disposal and prepare the water for reuse or discharge through an authorized outfall.

All shipboard cooling water and process water shall be directed away from contact with spent abrasive, paint and other debris. Contact of spent abrasive and paint with water will be prevented by proper segregation and control of wastewater streams. When debris is present, hosing of the dock shall not take place.

For vessels in which sanitary waste tanks (holding tanks) are installed, all sanitary wastes from the vessels shall be removed and disposed of by a commercial waste disposal company or discharged into the shipyard's sanitary waste system.

For vessels without sanitary waste holding tanks installed, the vessel's sanitary systems shall not be permitted to discharge overboard into the adjacent river. Vessels

without holding tanks shall be connected to a holding tank or shoreside system in compliance with Virginia Department of Health Regulations.

air quality control, Virginia has developed the Virginia Air Pollution Control Law (Title 10.1, Chapter 13 of the Code of Virginia). This law fulfills Virginia's responsibilities under the EPA's Federal Clean Air Act and serves as a basis for Virginia's Department of Air Pollution Control's "Regulations for the Control and Abatement of Air Pollution" (16).

To implement the Virginia Air Pollution Control Law at the shipyard level, the Virginia Department of Air Pollution Control develops memoranda of understanding with individual organizations. A typical memorandum of understanding with a shipyard is about three pages in length and stipulates requirements such as those shown below (17).

- Establish, implement, and submit a written policy and procedure for outdoor abrasive blasting and spray painting operations which takes "reasonable precautions to prevent particulate matter from becoming airborne." This procedure shall be subject to mutual agreement.

- Install wind direction and wind speed instruments located conveniently to central shipyard outdoor abrasive blasting and spray paint operations, and shall maintain records of wind direction and speed.

- Terminate abrasive blasting or spray painting operations if the wind speed exceeds a sustained 25 (twenty-five) miles per hour at the facility, unless effective containment methods are utilized or wind direction is such that particulate matter will not be improperly transported to adjacent property.

- Use adequate containment methods such as curtains or shrouds where possible and practical, and locate the operations to minimize particulate matter from being transported adjacent property. When **it is** not possible and practical to take reasonable precautions to prevent particulate matter from becoming airborne and the wind direction and speed is such that particulate matter is transported to adjacent property abrasive blasting or spray painting operations will be terminated.

Thus, the content and scope of the air quality memorandum of understanding is similar to the BMP approach, even though Virginia has established numerical ambient air quality standards. These are set forth in Reference 16. For example, **Section 120-03-02 states that the primary ambient air quality standards** for particulate matter are a maximum 24-hour concentration (not to be exceeded more than once per year) of 260 micrograms per cubic meter, and an annual geometric mean of 75 micrograms per cubic meter.

Hawaii State and Local Requirements

Water Quality Control. As is the case with other states, Hawaii operates its water quality program within the EPA framework. Hawaii's water quality control requirements are set forth in Chapter 342 of the "Hawaii Revised Statutes." The water quality program is administered by the State Department of Health, which uses its Water Quality Standards" (18) to provide the administrative guidelines. The "Water Quality Standards" classifies the State waters for various uses: provides water quality criteria: and describes water quality certification and inspection and analysis. The Hawaiian State Department of Health issues NPDES permits to facilities.

The draft NPDES permit issued by Hawaii to the floating drydock COMPETENT (AFDM 6) is an example of effluent limitations at the Naval Submarine Base, Pearl Harbor (19).

Air Quality Control. Hawaii's air quality control requirements are set forth in Chapter 342 of the "Hawaii Revised Statutes." The air quality program is administered by the State Department of Health, which uses its "Air Pollution Control Rules" (20) to provide the administrative guidelines. The "Air Pollution Rules" describe prohibitions and general requirements, describe and limit open burning, discuss stationary sources of air pollution, and discuss source applicability and exemptions. The rules are general in nature.

California State and Local Requirements

Water Quality Control. The California water quality requirements are contained in the Porter-Cologne Water Quality Control Act (21) and the Water Quality Control Plan for Enclosed Bays and Estuaries of California (22). The State Water Resources Control Board is designated as the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act and is authorized to issue NPDES permits. Under the State Board are nine regional boards, one of which is the San Diego

Regional Board, to implement the Act at the regional level.

The requirements in (21 and 22) are not specific to drydocks, but are general in nature. Following are examples of water quality objectives from Reference (22):

Narrative Water Quality Objectives

Enclosed bay and estuarine communities and populations, including vertebrate, invertebrate, and plant species, shall not be degraded as a result of the discharge of waste.

The natural taste and odor of fish, shellfish, or other enclosed bay and estuarine resources used for human consumption shall not be impaired.

Toxic pollutants shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health.

The concentrations of toxic pollutants in the water column, sediments, or biota shall not adversely affect beneficial uses.

Toxicity Objectives

There shall be no acute toxicity in ambient waters, including mixing zones.

There shall be no chronic toxicity in ambient waters outside mixing zones.

Numerical Water Quality Objectives

For enclosed bays and estuaries, numerical water quality objectives for the protection of saltwater aquatic life are presented (in Tables 1 and 2 of Reference 22).

Air Quality Control. Information for air quality requirements are contained in Titles 13, 17 and 26 of the California Code of Regulations. The Code designates that the Air Resources Board is the State agency charged with coordinating efforts to attain and maintain ambient air quality standards and to conduct research into the causes of and solution to air pollution. The Air Resources Board publishes a document entitled "California Air Pollution Control Laws" (23), which restates the air quality laws of the California and serves as a guide for the public and the Board.

California is divided into air pollution control districts. One of these districts is the County of San

Diego Air Pollution Control District, which publishes a guidance document entitled "Rules and Regulations" (24) and issues permits to operate equipment that may pollute the air. For example, the District issued a permit to the Naval Submarine Base, San Diego for ARCO (ARDM 5) to operate the diesel engines for its two cranes; to operate its emergency diesel generator; and to apply marine coatings (25).

EXISTING DRYDOCK ENVIRONMENTAL PROTECTION APPROACHES

Following are three examples of how floating drydocks comply with Federal, state and local water and air quality control requirements. The examples are National Steel and Shipbuilding Company's NASSCO BUILDER; Southwest Marine's PRIDE OF SAN DIEGO and the U.S. Navy's ARCO (ARDM 5). All three facilities are located in San Diego Harbor. Their environmental protection approaches are summarized in Table I.

TABLE I
APPROACHES TO DRYDOCK
ENVIRONMENTAL PROTECTION

Approach	NASSCO	SWM	ARDM	AFDB
			5	10
Sedimentation Sump and Pump	x	xx		x
CHT With Connection to Shore	x	xx		x
Abrasive Blasting Shrouds	x	x		
Pontoon Deck Coaming	x	xx		x
Manual Sweeping of Pontoon Deck	x	xx		x

National Steel and Shipbuilding Company

The environmental protection approach of National Steel and Shipbuilding Company (NASSCO) is contained in its "Best Management Practices Plan" (26). This document addresses environmental protection from a shipyard-wide perspective and includes sections on policy, objectives, risk identification and assessment, reporting of BMP incidents, inspections, records and training. Its focus is operational in nature.

One part of the BMP is NASSCO's water pollution control plan. It states that "NASSCO's general strategy for water pollution shall be the-- continued avoidance of the deliberate discharge of any waste category directly into San

Diego Bay." Regarding their steel floating drydock, NASSCO BUILDER, the policy is that "no deliberate discharge into San Diego Bay of any waste category shall be allowed."

Southwest Marine, Inc.

Southwest Marine's BMP (27, 28) is similar in scope and content to that of NASSCO, as are the procedures followed aboard the company's drydocks, such as the 22,000-ton, steel floating drydock, the PRIDE OF SAN DIEGO.

ARDM 5

The Navy's steel, 7800 ton capacity floating drydock ARDM 5 (ARCO) is spud moored to a concrete pier at the Naval Submarine Base, Point Loma, San Diego. ARCO provides docking services to Navy attack submarines.

For ARDM 5, the Navy's environmental pollution control approach is similar to those of NASSCO and Southwest Marine. The environmental features aboard ARDM 5 for water quality control include a sedimentation sump and pump system and a CHT system. There is no need for air particulate containment curtains on ARDM 5, because sandblasting is not carried out: hydro-blasting is used instead.

For air quality control, ARDM 5 holds permits to operate two non-emergency diesel engines (for its two traveling cranes): one emergency diesel generator: and one marine coating application station (30). All three permits were issued by The County of San Diego Air Pollution Control District.

For the non-emergency diesel engines, the permit restricts operating time on an hours-per-day and an hours-per-week basis; the number of gallons of fuel on a gallons-per-day and a gallons-per-year basis; and the sulfur content in the fuel. Also, daily records of fuel usage must be maintained, and the engines may be operated only with turbo chargers and aftercoolers functioning (the emergency diesel engine permit does not include these restrictions).

The marine coating application station permit is for four Grace Hydra-Spray supply pumps and eight Wagner Airless spray guns. The permit requires that detailed daily records be maintained.

ENVIRONMENTAL PROTECTION ON AFDB 10

AFDB 10 is the Navy's newest floating drydock. It is still in the design stage. The design approach to ensure that AFDB 10 complies with applicable Federal, state and local water quality and air quality requirements is twofold:

- 1) Minimize the production of pollutants, and
- 2) Maintain maximum control of any pollutants that are produced.

Table I summarizes the environmental protection features on this drydock.

As is the case on ARDM 5, there will be no grit blasting, only water blasting on AFDB 10. Thus, there is no need for air particulate containment curtains. Also, the cranes are electrically powered, so there will be no diesel emissions during normal operations. Finally, AFDB 10 has a stand-by diesel-generator system. This will be operated only if shore power is interrupted and, thus, emits a minimal amount of pollution into the air.

CONCLUSIONS

The Federal government and the governments of the three states reviewed have developed detailed requirements to help control environmental pollution. These requirements are becoming more stringent and they are becoming more detailed in their scope. For example, new requirements focus on particular industries, such as the marine industry, and on specific types of facilities, such as floating dry docks. Commercial and Navy facilities are complying with the requirements. In particular, the Navy's newest floatina drydock, AFDB 10, will incorporate environmental pollution control features that were instituted at the inception of its design.

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 18. "Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards," January 1990.
 19. "Authorization to Discharge Under the National Pollutant Discharge Elimination System (Draft), United States Navy, Submarine Base Floating Drydock AFDM-6, Pearl Harbor, Hawaii 96863 ." Permit Number HI 1121032. State- Department of Health; Honolulu, HI, September 23, 1991.
 20. "Hawaii Administrative Rules, Title 11, Department of Health, Chapter 60, Air Pollution Control," April 1986.
 21. "The Porter-Cologne Water Quality Control Act," California State Water Resources Control Board, Sacramento, CA 1989.
 22. **California Enclosed Bays and Estuaries Plan," 91-13 WQ, Water Resources Control Board, State of California, April 1991.
 23. "California Air Pollution Control Laws, 1991 Edition," California Air Resources Board, Sacramento, CA.
 24. "Rules and Regulations," County of San Diego, Air Pollution Control District, San Diego, CA, November 1991.
 25. "ARC0 (ARDM-5) Environmental Operating -Permits Issued by County of San Diego, CA,** Memorandum from 1st Lt., ARC0 (ARDM-5) to Ross-McNatt, October 28, 1992.
 26. 'Best Management Practices Plan," National Steel and Shipbuilding Company, Harbor Drive and 28th Street, San Diego, CA.
 27. Shipcheck of NASSCO BUILDER by Jonathan M. Ross (Ross-McNatt Naval Architects), Hosted by Frank Russell (Dockmaster), National Steel and Shipbuilding Company, March 5, 1991.
 28. "southwest Marine Yard 4 NPDES Best Management Practices Plan, Permit No. CA0107697; Order No. 83-11, Facility Permit.
 29. Meeting of Steve Richardson (South-West Marine Environmental Coordinator), Dana Austin (South-West Marine Corporate Environmental Manager), George Curtis (Norfolk Ship Company) and Jonathan Ross (Ross-McNatt Naval Architects) at Southwest Marine Yard 4, San Diego, California, March 6, 1991.
 30. Department of the Navy Memorandum, From 1st LT, ARC0 (ARDM 5) to Ross-McNatt, October 28, 1991.

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